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## Tank Characterization Report for Single-Shell Tank 241-S-109

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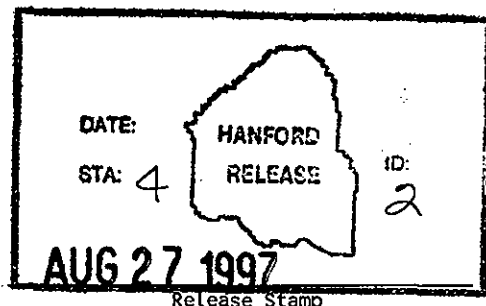
Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-S-109. This report supports the requirements of the Tri-Party Agreement Milestone M-44-10.

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*John J. Broz*  
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**LIST OF TERMS**

$\mu\text{Ci/g}$	microcuries per gram
$\mu\text{Ci/L}$	microcuries per liter
$\mu\text{g}$	microgram
$\mu\text{g/g}$	micrograms per gram
A/C	aluminum to caustic ratio
ANOVA	analysis of variance
Btu/hr	British thermal units per hour
CEO	change engineering order
CF	concentration factor
Ci	curies
Ci/L	curies per liter
CI	confidence interval
cm	centimeter
CWR	REDOX cladding waste
CWR1	REDOX cladding waste from 1952 to 1960
DOE	U.S. Department of Energy
DQO	data quality objective
DSC	differential scanning calorimetry
EB	evaporator bottoms
ECN	engineering change notice
Ecology	Washington State Department of Ecology
FIC	Food Instrument Corporation
ft	feet
g	grams
g/cc	grams per cubic centimeter
g/L	grams per liter
g/mL	grams per milliliter
GEA	gamma energy analysis
HHF	hydrostatic head fluid
HDW	Hanford defined waste
HTCE	historical tank content estimate
IC	ion chromatography
ICP	inductively coupled plasma spectroscopy
in.	inch
J/g	joules per gram
kg	kilogram
kg/L	kilograms per liter
kgal	kilogallon
kL	kiloliter
kW	kilowatt



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**LIST OF TERMS (Continued)**

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L	liter
LANL	Los Alamos National Laboratory
LL	lower limit
LOW	liquid observation well
m	meter
<u>M</u>	moles per liter
mm	millimeter
mrad/hr	millirads per hour
MT	metric ton
n/a	not applicable
NR	not reviewed
PF	partitioning factor
PHMC	Project Hanford Management Contractor
PN/S	partial neutralized inventory/analytical inventory
ppm	parts per million
R	REDOX High level waste from 1952 to 1960
RCW	REDOX Coating Waste
REDOX	Reduction Oxidation facility
RPD	relative percent difference
S	analytically determined inventory
SAP	sampling and analysis plan
SMMS1	supernate mixing model for 242-S Evaporator, 1973-1976
SST	single-shell tank
S1SlCk	242-S Evaporator saltcake waste, 1973-76
TCP	tank characterization plan
TCR	tank characterization report
TGA	thermogravimetric analysis
TIC	total inorganic carbon
TLM	tank layer model
TOC	total organic carbon
TWRS	Tank Waste Remediation System
UL	upper limit
W	watts
WSTRS	waste status and transaction record summary
wt%	weight percent

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### 3.0 BEST BASIS INVENTORY ESTIMATE

Information about chemical, radiological and/or physical properties of tank waste is used to perform safety analyses, engineering evaluations, and risk assessment associated with waste management activities, as well as with regulatory issues. These activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank waste. Disposal activities involve designing equipment, processes, and facilities for retrieving waste and processing it into a form that is suitable for long-term storage. Chemical and radiological inventory information are generally derived using three approaches: component inventories are estimated using the results of sample analyses, component inventories are predicted using the HDW model based on process knowledge and historical information, and a tank-specific process estimate is made based on process flowsheets, reactor fuel data, essential material use, and other operating data. Not surprisingly, the information derived using these different approaches is often inconsistent.

An effort is under way to provide waste inventory estimates that will serve as the standard characterization for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, available chemical information for 241-S-109 was evaluated. The information included the following:

- Data from 1996 partial core samples (Fritts 1996).
- An inventory estimate generated by the HDW model (Agnew et al. 1996b).
- An evaluation of the average REDOX high level waste (R) flowsheet.

The best basis inventory evaluation is included in Appendix D. Based on this evaluation, a best basis inventory was developed (Tables 3-1 and 3-2). In general, the sample-based results were preferred when they were reasonable and consistent with other results. Process estimates were added to the sample-based results for the analytes that appear on the R flowsheet. This was done to add the estimated contribution from the sludge layer, which was a minor component of this tank. Because no sample was available for this layer, the engineering assessment must be considered to have a low confidence value. The HDW model was used only where no other data were available.

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-S-109 (11/9/96).

Analyte	Total Inventory (kg)	Basis (S, M, or E) <sup>1,2</sup>	Comment
Al	19,000	E	This value may be as much as 4 times too high.
Bi	288	M	
Ca	245	E	
Cl	937	E	
TIC as CO <sub>3</sub>	12,000	E	
Cr	5,370	E	
F	1,450	M	
Fe	3,410	E	
Hg	42.6	M	
K	3,350	M	
La	4.0E-03	M	
Mn	54.4	E	
Na	6.25E+05	E	
Ni	667	M	
NO <sub>2</sub>	11,360	E	This value may be as much as 10 times too low, based on similar tanks.
NO <sub>3</sub>	1.47E+06	E	
OH	67,700	C	
Pb	1,480	M	
P as PO <sub>4</sub>	30,900	E	
Si	977	E	
S as SO <sub>4</sub>	20,040	E	
Sr	8.41E-04	M	
TOC	1,510	E	
U <sub>TOTAL</sub>	142	E	
Zr	87.2	M	

## Notes:

- <sup>1</sup>S = Sample-based  
M = Hanford Defined Waste model-based  
E = Engineering assessment-based  
C = Calculated by charge balance, including oxides as hydroxides, not including CO<sub>3</sub>, NO<sub>2</sub>, NO<sub>3</sub>, PO<sub>4</sub>, SO<sub>4</sub>, and SiO<sub>3</sub>.

<sup>2</sup>Sample data were not used because sample recovery was poor, and samples were obtained from only the upper portion of the tank (see Appendix B).

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-109 (11/9/96). (2 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E) <sup>1,2</sup>	Comments
<sup>3</sup> H	490	M	
<sup>14</sup> C	63.8	M	
<sup>59</sup> Ni	4.28	M	
<sup>60</sup> Co	65.2	M	
<sup>63</sup> Ni	416	M	
<sup>79</sup> Se	6.54	M	
<sup>90</sup> Sr	2.75 E+05	E	Based on calculations from dome space temperatures
<sup>90</sup> Y	2.75E+05	E	
<sup>93</sup> Zr	31.9	M	
<sup>93m</sup> Nb	23.6	M	
<sup>99</sup> Tc	454	M	
<sup>106</sup> Ru	1.02E-02	M	
<sup>113m</sup> Cd	157	M	
<sup>125</sup> Sb	269	M	
<sup>126</sup> Sn	9.90	M	
<sup>129</sup> I	0.875	M	
<sup>134</sup> Cs	2.86	M	
<sup>137</sup> Cs	1.06 E+05	E	Based on calculations from dome space temperatures
<sup>137m</sup> Ba	1.00E+05	E	
<sup>151</sup> Sm	2.31E+04	M	
<sup>152</sup> Eu	5.84	M	
<sup>154</sup> Eu	1.04E+03	M	
<sup>155</sup> Eu	336	M	
<sup>226</sup> Ra	3.01E-04	M	
<sup>227</sup> Ac	1.82E-03	M	
<sup>228</sup> Ra	0.111	M	
<sup>229</sup> Th	2.65E-03	M	
<sup>231</sup> Pa	8.07E-03	M	

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-109 (11/9/96). (2 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E) <sup>1,2</sup>	Comments
<sup>232</sup> Th	7.51E-03	M	
<sup>232</sup> U	0.676	M	
<sup>233</sup> U	2.59	M	
<sup>234</sup> U	2.30	M	
<sup>235</sup> U	9.60E-02	M	
<sup>236</sup> U	6.11E-02	M	
<sup>237</sup> Np	1.78	M	
<sup>238</sup> Pu	3.46	M	
<sup>238</sup> U	2.35	M	
<sup>239</sup> Pu	161	M	
<sup>240</sup> Pu	24.7	M	
<sup>241</sup> Am	106	M	
<sup>241</sup> Pu	2.16	M	
<sup>242</sup> Cm	0.210	M	
<sup>242</sup> Pu	1.09E-03	M	
<sup>243</sup> Am	3.05E-03	M	
<sup>243</sup> Cm	1.89E-02	M	
<sup>244</sup> Cm	0.208	M	

## Notes:

<sup>1</sup>S = Sample-based  
M = Hanford Defined Waste model-based  
E = Engineering assessment-based  
NR = Not reported

<sup>2</sup>Sample data were not used because sample recovery was poor and samples were obtained from only the upper portion of the tank (see Appendix B). Model estimates taken from Agnew (1997).

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**APPENDIX D****EVALUATION TO ESTABLISH BEST-BASIS  
INVENTORY FOR TANK 241-S-109****D1.0 BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-S-109**

The following evaluation provides a best-basis inventory estimate for chemical and radionuclide components in tank 241-S-109.

**D1.1 EXPECTED TYPE OF WASTE BASED ON THIS ASSESSMENT**

Agnew et al. (1996b)	SMMS1, CWR1
Hill et al. (1995)	B, R

It is not known whether the sludge layer in the tank is R cladding waste (CWR1) or R waste. Based on tank transfer history (Agnew et al. 1996a) and radioactivity estimates determined from tank headspace temperatures (see Appendix E), it is assumed that the small sludge layer is R waste and not CWR1 as reported in Agnew et al. (1996b).

**D1.2 TANK INVENTORY ESTIMATES**

Two inventories have been developed for Tank 241-S-109. A sampling inventory, based on core sampling results (Fritts 1996) and the HDW inventory (Agnew et al. 1996b). The sampling and HDW inventories can not be compared directly, because they are calculated differently. The sample inventory was based on partial core samples taken from two risers. None of the sludge expected at the bottom of the tank was recovered during this sampling event. Consequently, the sample inventory is only for the saltcake portion of the tank or 1,870 kL (494 kgal) and is calculated based on a mean sample density of 1.3 g/mL. Further, the sample inventory in Table D1-1 assumes that the small portion of saltcake recovered is representative of the entire saltcake volume. This is not necessarily true, as discussed in section D3.0. The HDW inventory (Agnew et al. 1996b) includes both the saltcake and sludge volumes for a total volume of 1,920 kL (507 kgal). The HDW inventory is calculated using an estimated average density of 1.5 g/mL for the tank.

The sampling and HDW inventories (Tables D1-1 and D1-2) provide a starting point for calculating a best-basis inventory for the tank that combines the best information from the sampling data, modeling estimates, and process information. The chemical species are reported without charge designation according to the best-basis inventory convention.

Table D1-1. Sampling-Based and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-S-109. (2 sheets)

Analyte	Sampling <sup>1</sup> Inventory Estimate (kg)	HDW <sup>2</sup> Inventory Estimate (kg)	Analyte	Sampling <sup>1</sup> Inventory Estimate (kg)	HDW <sup>2</sup> Inventory Estimate (kg)
Al	4,215	97,000	Ni	NR	667
Ag	43.1	NR	NO <sub>2</sub>	11,360	2.29E+5
As	NR	NR	NO <sub>3</sub>	1.46E+6	5.55E+5
Ba	NR	NR	OH	NR	2.56E+5
Be	NR	NR	oxalate	NR	2.17E-3
Bi	NR	288	Pb	NR	1,480
Ca	245	2,570	Pd	NR	NR
Ce	NR	NR	P as PO <sub>4</sub>	30,900	11,300
Cd	NR	NR	Pt	NR	NR
Cl	937	11,900	Rh	NR	NR
Co	NR	NR	Ru	NR	NR
Cr	3,790	NR	Sb	NR	NR
Cr <sup>+3</sup>	NR	6,810	Se	NR	NR
Cr <sup>+6</sup>	NR	NR	Si	977	3,700 (as SiO <sub>3</sub> )
Cs	NR	NR	S as SO <sub>4</sub>	19,950	33,000
Cu	NR	NR	Sr	NR	8.41E-4
F	NR	1,450	Te	NR	NR
Fe	3,190	1,170	TIC	12,000	32,600
FeCN/CN	NR	NR	Th	NR	NR
formate	NR	NR	Tl	NR	NR
Hg	NR	42.6	TOC	1,510	0.358 ( wt% C)
K	NR	3,350	U <sub>total</sub>	142	7,440
La	NR	4.0E-3	V	NR	NR
Mg	NR	NR	W	NR	NR



Table D1-1. Sampling-Based and Hanford Defined Waste-Based Inventory Estimates for Nonradioactive Components in Tank 241-S-109. (2 sheets)

Analyte	Sampling <sup>1</sup> Inventory Estimate (kg)	HDW <sup>2</sup> Inventory Estimate (kg)	Analyte	Sampling <sup>1</sup> Inventory Estimate (kg)	HDW <sup>2</sup> Inventory Estimate (kg)
Mn	54.4	318	Zn	47.8	NR
Mo	NR	NR	Zr	NR	87.2 (as ZrO(OH) <sub>2</sub> )
Na	6.2E+5	4.67E+5	H <sub>2</sub> O (Wt%)	NR	40.1
Nd	NR	NR	density (kg/L)	1.3	1.52
NH <sub>4</sub>	NR	1,800			

Notes:

<sup>1</sup>Fritts (1996)<sup>2</sup>Agnew et al. (1996b)

Table D1-2. Sampling and Predicted Inventory Estimates for Radioactive Components in Tank 241-S-109.

Analyte	Sampling <sup>1</sup> Inventory Estimate (Ci)	HDW <sup>2</sup> Inventory Estimate (Ci)	Analyte	Sampling <sup>1</sup> Inventory Estimate (Ci)	HDW <sup>2</sup> Inventory Estimate (Ci)
<sup>14</sup> C	NR	NR	<sup>237</sup> Np	NR	NR
<sup>90</sup> Sr	2.76E+5	2.14E+5	<sup>239/240</sup> Pu	NR	255
<sup>99</sup> Tc	NR	NR	<sup>241</sup> Am	NR	NR
<sup>129</sup> I	NR	NR	Total α	18.7	NR
<sup>137</sup> Cs	1.06E+5	4.82E+5	Total β	NR	NR
<sup>154</sup> Eu	NR	NR			

Notes:

<sup>1</sup>Fritts (1996)<sup>2</sup>Agnew et al. (1996b).

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## D2.0 INVENTORY EVALUATION

The following evaluation provides an engineering assessment of tank 241-S-109 contents. For this evaluation, the following assumptions and observations are made:

- Tank waste mass is calculated using the measured density of the saltcake (1.3 g/mL) and the tank volume listed by Agnew et al. (1996b), which is 494 kgal of saltcake, and 13 kgal of sludge.
- Only the SMMS1 and R waste streams contributed to solids formation.
- Bulk component information for the sludge layer is sufficient for comparing analytical and predicted data sets. This information can be obtained from technical flowsheets (refer to Table D2-1). Note in this case there is no analytical data so only the technical flowsheet information is available.
- No radiolysis of  $\text{NO}_3$  to  $\text{NO}_2$  and no additions of  $\text{NO}_2$  to the waste for corrosion purposes are factored into this evaluation.
- All Bi and Al precipitate.
- No Si from blowsand is factored into this evaluation.
- All  $\text{NO}_3$ , Na and  $\text{SO}_4$ , remain dissolved in the interstitial liquid.
- Interstitial liquid is a composite of all wastes. Contributions of dissolved components are weighted by volume.
- Concentration of components in interstitial liquid is based on a void fraction of 0.686 the average of (R1 and R2) as reported by Agnew et al. (1996b). This factor is higher than the present void fraction but is assumed to better represent the original void fraction.
- Cr and Fe partition between the liquid and solid phases.

Technical flowsheet information for the average R streams is provided in Table D2-1. The comparative LANL defined waste streams also are provided in this table. Note that the REDOX coating waste average flowsheet is also included for comparison purposes.

Table D3-1. Comparison of Selected Component Inventory Estimates for Tank 241-S-109 Waste.

Component	This evaluation (kg)	Sample-based (kg)	HDW estimated (kg)
Bi	> 3	NR	288
K	NR	NR	3350
La	NR	NR	4E-03
NO <sub>3</sub>	1.47E+06	1.46E+06	2.29E+05
Mn	NR	54.4	318
SO <sub>4</sub>	20,040	19,950	33,000
Cr	5370	3,790	6,810
PO <sub>4</sub>	NR	30,900	11,300
F	NR	NR	1450
Al	19,000	4,215	97,000
Fe	3,410	3,190	1,170
Na	6.25E+05	6.2E+05	4.67E+05
H <sub>2</sub> O (percent)		NR	40.1

Note:

HDW = Hanford Defined Waste

NR = Not reported.

**Bismuth.** Because the sample-based value was not reported, no meaningful comparison is available to the HDW model. The inventory from the sludge layer was 3.1 kg but no saltcake value is given. The Bi is therefore >3 but probably less than 288, the HDW model estimate.

**Nitrate.** The HDW estimated inventory is smaller than the sample-based inventory by about six times and the inventory estimated in this evaluation adds less than 1 percent to the sampling results. It is not known why this difference is occurring, but it most likely is because of incorrect feed in information to the model. When no reason for differences is given for other analytes, a model associated problem will be the assumed most likely reason.

**Sulfate.** The engineering evaluation added the flowsheet sludge prediction to that portion of the sample-based calculations that represents the expected sludge volume. The engineering evaluation was used as the best basis because this portion of the tank was not sampled. It is

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essentially the same value as the sample predicted. The HDW model predicts about 50 percent more than the other values.

**Chromium.** The HDW estimated inventory is over 80 percent higher than the sample-based inventory. The estimate from this evaluation is about half way between the other two estimates. The additional amount from the engineering estimate is from flowsheet estimates for Cr in the sludge, which is a much higher molarity than that of the saltcake. The sample-based inventory did not measure the sludge layers of the tank. The engineering estimate was used for the best basis.

**Phosphate.** The sample-based estimate was used as the best basis because a good prediction of the sludge molarity could not be made from flowsheet information. This estimate is about three times higher than that predicted by the HDW model.

**Fluoride.** The sample-based estimate was not reported and because a good prediction of the sludge molarity could not be made from flowsheet information, the best basis is that predicted by the HDW model.

**Sodium.** The engineering estimate is about 1 percent higher than the sample-based estimate because sludge is much lower than saltcake in Na, so little Na was added by the sludge. This engineering estimate was used as the best basis and it is about 35 percent higher than that predicted by the HDW model.

**Potassium.** There is no sample-based estimate and because a good prediction of the sludge molarity could not be made from flowsheet information, the HDW model estimate becomes the best-basis estimate.

**Lanthanum.** There is no sample-based estimate and because a good prediction of the sludge molarity could not be made from flowsheet information, the best basis is that predicted by the HDW model.

**Manganese.** The sample-based estimate was used as the best basis because a good prediction of the sludge molarity could not be made from flowsheet information. This best basis is about six times lower than that predicted by the HDW model.

**Aluminum.** Like Cr, Al engineering calculations based on the R sludge add significant amounts of analyte to the inventory. The engineering based inventory was used as the best basis and is over five times the sample-based estimate. Because only the upper half of the saltcake was analyzed and similar tanks (241-U-102, 241-S101 and 241-S-102) show twice the Al in the bottom half of the saltcake, the analytical saltcake number was multiplied by 1.5, and was added to the sludge value to give the best basis calculation. The HDW model predicted a value about four and a half times that of this estimate. Although no quality control problems were identified in the sample data, based on Agnew et al. (1996b) and process data from tanks containing similar waste types, the sample-based numbers for Al

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appear to be low. This is being investigated. The engineering estimate is used as the best basis with a caution that it may be up to four times too high.

**Iron.** Using the R flowsheet information to estimate Fe in the sludge adds less than 10 percent to the saltcake values from the sample-based value. The HDW model predicts about one third of this value.

**Total Hydroxide.** Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. In some cases, this approach required that other analyte (e.g., sodium or nitrate) inventories be adjusted to achieve the charge balance. During such adjustments, the number of significant figures was not increased. This charge balance approach is consistent with that used by Agnew et al. (1977).

#### D4.0 BEST-BASIS INVENTORY ESTIMATE

Information about chemical, radiological and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessment associated with waste management activities, as well as regulatory issues. These activities include overseeing tank farm operations and identifying, monitoring and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes and facilities for retrieving wastes and processing them into a form that is suitable for long-term storage. Chemical and radiological inventory information are generally derived using three approaches: (1) component inventories are estimated using the results of sample analyses, (2) component inventories are predicted using the HDW model based on process knowledge and historical information, or (3) a tank-specific process estimate is made based on process flowsheets, reactor fuel data, essential material usage and other operating data. Not surprisingly, the information derived from these different approaches is often inconsistent.

An effort is underway to provide waste inventory estimates that will serve as the standard characterization for the various waste management activities (Hodgson and LeClair 1995). As part of this effort, an evaluation of available chemical information for 241-S-109 was performed, including:

- Data from 1996 partial core samples (Fritts 1996).
- An inventory estimate generated by the HDW model (Agnew et al. 1996b).
- Evaluation of the average R flowsheet

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Based on this evaluation, a best-basis inventory was developed (see Tables D4-1 and D4-2). In general, the sample-based TCR results were preferred when they were reasonable and consistent with other results. Process estimates were added to the sample-based results for those analytes that appear on the R flowsheet. This was done to add the estimated contribution from the sludge layer, which was a minor component of this tank. Because no sample was available for this layer the engineering assessment must be considered to have a low confidence value. The HDW model was used only where no other data were available.

The best-basis inventory for tank 241-S-109 is presented in Tables D4-1 and D4-2. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database for the most current inventory values.

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$ ,  $^{239/240}\text{Pu}$ , and total uranium, or (total beta and total alpha) while other key radionuclides such as  $^{60}\text{Co}$ ,  $^{99}\text{Tc}$ ,  $^{129}\text{I}$ ,  $^{154}\text{Eu}$ ,  $^{155}\text{Eu}$ , and  $^{241}\text{Am}$  etc., were infrequently reported. For this reason, it was necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997). Model generated values for radionuclides in the 177 tanks were reported in Agnew et al. (1997). The best-basis value for any one analyte may be a model result, a sample, or an engineering assessment-based result, if available. (No attempt was made to ratio or normalize model results for all 46 radionuclides when values for measured radionuclides disagree with the model). For a discussion of typical error between model-derived values and sample-derived values, see Kupfer et al. (1997, Section 6.1.10).

Best-basis tables for chemicals and only four radionuclides ( $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$ , Pu and U) were being generated in 1996, using values derived from an earlier version (Rev. 3) of the Hanford Defined Waste model. When values for all 46 radionuclides became available in Rev. 4 of the HDW model, they were merged with draft best-basis chemical inventory documents. Defined scope of work in FY 1997 did not permit Rev. 3 chemical values to be updated to Rev. 4 chemical values.

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-S-109 (11/9/96).

Analyte	Total Inventory (kg)	Basis (S, M, or E) <sup>1,2</sup>	Comment
Al	19,000	E	This value may be as much as 4 times too high.
Bi	288	M	
Ca	245	E	
Cl	937	E	
TIC as CO <sub>3</sub>	12,000	E	
Cr	5,370	E	
F	1,450	M	
Fe	3,410	E	
Hg	42.6	M	
K	3,350	M	
La	4.0E-03	M	
Mn	54.4	E	
Na	6.25E+05	E	
Ni	667	M	
NO <sub>2</sub>	11,360	E	This value may be as much as 10 times too low, based on similar tanks.
NO <sub>3</sub>	1.47E+06	E	
OH	67,700	C	
Pb	1,480	M	
P as PO <sub>4</sub>	30,900	E	
Si	977	E	
S as SO <sub>4</sub>	20,040	E	
Sr	8.41E-04	M	
TOC	1,510	E	
U <sub>TOTAL</sub>	142	E	
Zr	87.2	M	

## Notes:

- <sup>1</sup>S = Sample-based  
M = Hanford Defined Waste model-based  
E = Engineering assessment-based  
C = Calculated by charge balance, including oxides as hydroxides, not including CO<sub>3</sub>, NO<sub>2</sub>, NO<sub>3</sub>, PO<sub>4</sub>, SO<sub>4</sub>, and SiO<sub>3</sub>.

<sup>2</sup>Sample data were not used because sample recovery was poor, and samples were obtained from only the upper portion of the tank (see Appendix B).

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components  
in Tank 241-S-109 (11/9/96). (2 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E) <sup>1,2</sup>	Comments
<sup>3</sup> H	490	M	
<sup>14</sup> C	63.8	M	
<sup>59</sup> Ni	4.28	M	
<sup>60</sup> Co	65.2	M	
<sup>63</sup> Ni	416	M	
<sup>79</sup> Se	6.54	M	
<sup>90</sup> Sr	2.75 E+05	E	Based on calculations from dome space temperatures
<sup>90</sup> Y	2.75E+05	E	
<sup>93</sup> Zr	31.9	M	
<sup>93m</sup> Nb	23.6	M	
<sup>99</sup> Tc	454	M	
<sup>106</sup> Ru	1.02E-02	M	
<sup>113m</sup> Cd	157	M	
<sup>125</sup> Sb	269	M	
<sup>126</sup> Sn	9.90	M	
<sup>129</sup> I	0.875	M	
<sup>134</sup> Cs	2.86	M	
<sup>137</sup> Cs	1.06 E+05	E	Based on calculations from dome space temperatures
<sup>137m</sup> Ba	1.00E+05	E	
<sup>151</sup> Sm	2.31E+04	M	
<sup>152</sup> Eu	5.84	M	
<sup>154</sup> Eu	1.04E+03	M	
<sup>155</sup> Eu	336	M	
<sup>226</sup> Ra	3.01E-04	M	
<sup>227</sup> Ac	1.82E-03	M	
<sup>228</sup> Ra	0.111	M	
<sup>229</sup> Th	2.65E-03	M	
<sup>231</sup> Pa	8.07E-03	M	



Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-S-109 (11/9/96). (2 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E) <sup>1,2</sup>	Comments
<sup>232</sup> Th	7.51E-03	M	
<sup>232</sup> U	0.676	M	
<sup>233</sup> U	2.59	M	
<sup>234</sup> U	2.30	M	
<sup>235</sup> U	9.60E-02	M	
<sup>236</sup> U	6.11E-02	M	
<sup>237</sup> Np	1.78	M	
<sup>238</sup> Pu	3.46	M	
<sup>238</sup> U	2.35	M	
<sup>239</sup> Pu	161	M	
<sup>240</sup> Pu	24.7	M	
<sup>241</sup> Am	106	M	
<sup>241</sup> Pu	2.16	M	
<sup>242</sup> Cm	0.210	M	
<sup>242</sup> Pu	1.09E-03	M	
<sup>243</sup> Am	3.05E-03	M	
<sup>243</sup> Cm	1.89E-02	M	
<sup>244</sup> Cm	0.208	M	

## Notes:

<sup>1</sup>S = Sample-based  
M = Hanford Defined Waste model-based  
E = Engineering assessment-based  
NR = Not reported

<sup>2</sup>Sample data were not used because sample recovery was poor and samples were obtained from only the upper portion of the tank (see Appendix B). Model estimates taken from Agnew (1997).

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